

TYPE II CEPHEIDS IN THE KEPLER K2 MISSION

M. I. Jurkovic^{1,2}, E. Plachy^{2,3}, L. Molnár^{2,3}, M. A. T. Groenewegen⁴ and R. Szabó^{2,3}**Abstract.**

Type II Cepheids (T2Cs) are old, low-mass ($0.5 M_{\odot}$) stars. They mainly pulsate in a radial mode, but recent discoveries have shown that there are first overtone pulsators among them, and they can exhibit a phenomenon called "period-doubling". They are separated into three subgroups according to their pulsation periods: BL Her, $1 < P [d] < 4$, W Vir: $5 < P [d] < 20$, RV Tau: $20 < P [d] < 150$. Anomalous Cepheids (ACs) have an average mass of $1.2 M_{\odot}$, and they pulsate in a fundamental mode and/or[?] in the first overtone. Their periods are in the range from 0.4 to 2.4 days. The Kepler space telescope's original field contained only a single RV Tau star, DF Cyg, but that changed during the K2 mission. Here we present the 12 stars that were observed in Campaigns 1 – 14 of the K2 mission. We have found Type II Cepheids in the sample that show "period doubling", and four possible anomalous Cepheids among the 12 stars.

Keywords: Stars: variables: Cepheids

1 Introduction and Data

The data for the Kepler K2 mission were downloaded from the Mikulski Archive for Space Telescopes database (MAST, <https://archive.stsci.edu>) and analysed with the Extended Aperture Photometry (EAP, Plachy et al. 2017). For each star, an individual aperture was applied, as seen in Figure 1 on the right for the star 218128117 from Campaign 7, where the telescope made significant jumps during the observing run. We have also used the magnitudes from the EPIC Variability Extraction and Removal for Exoplanet Science Targets (EVEREST, Luger et al. (2016)) pipeline for comparison. Table 1 gives the basic information about each star in the sample.

Table 1. The stars identified as T2Cs and ACs in the K2 mission.

Cycle	EPIC ID	RA (2000)	DEC (2000)	P [d]	<Kp> [mag]	Notes
2	202862302	16 36 52.85	-28 05 34.26	1.956	12.926	V1287 Sco: W Vir
4	210622262	04 20 01.80	+17 16 45.80	16.657	16.882	W Vir with PD
7	217235287	19 16 10.99	-20 55 55.86	1.259	15.155	V527 Sgr: BL Her
7	215881928	18 59 37.24	-23 21 52.27	1.835	14.606	V839 Sgr: BL Her
7	217987553	19 06 26.95	-19 36 35.25	13.448	12.482	V1077 Sgr: W Vir with cycle-to-cycle variations
7	218642654	19 06 03.14	-18 25 41.62	13.758	12.166	V410 Sgr: W Vir with PD?
7	217693968	18 48 09.79	-20 07 35.61	16.215	13.289	V377 Sgr: W Vir with PD
7	218128117	19 34 34.67	-19 21 39.96	2.119	12.735	AC?
12	246015642	23 39 54.14	-09 05 01.81	1.071	15.399	AC
12	246385425	23 15 26.54	-01 22 28.73	1.502	17.972	AC
12	246333644	23 22 33.11	-02 23 40.13	1.287	17.792	AC
13	247445057	05 05 14.27	+21 45 48.93	13.944	12.355	VZ Tau: W Vir with PD?

¹ Astronomical Observatory Belgrade, 11060 Belgrade, Serbia, Konkoly Observatory² Research Centre for Astronomy and Earth Sciences, H-1121 Budapest, Hungary³ MTA CSFK Lendület Near-Field Cosmology Research Group⁴ Koninklijke Sterrenwacht van België, 1180, Brussels, Belgium

2 Results

Our results can be summarized as follows:

- We have found four anomalous Cepheids (see Fig. 1).
- Two W Virginis stars show "period doubling" (PD). Star 217987553 does not show PD, but it does have an additional modulation (cycle-to-cycle variation).
- For two additional stars further analysis needs to be done to confirm if there is a PD in their light curves.

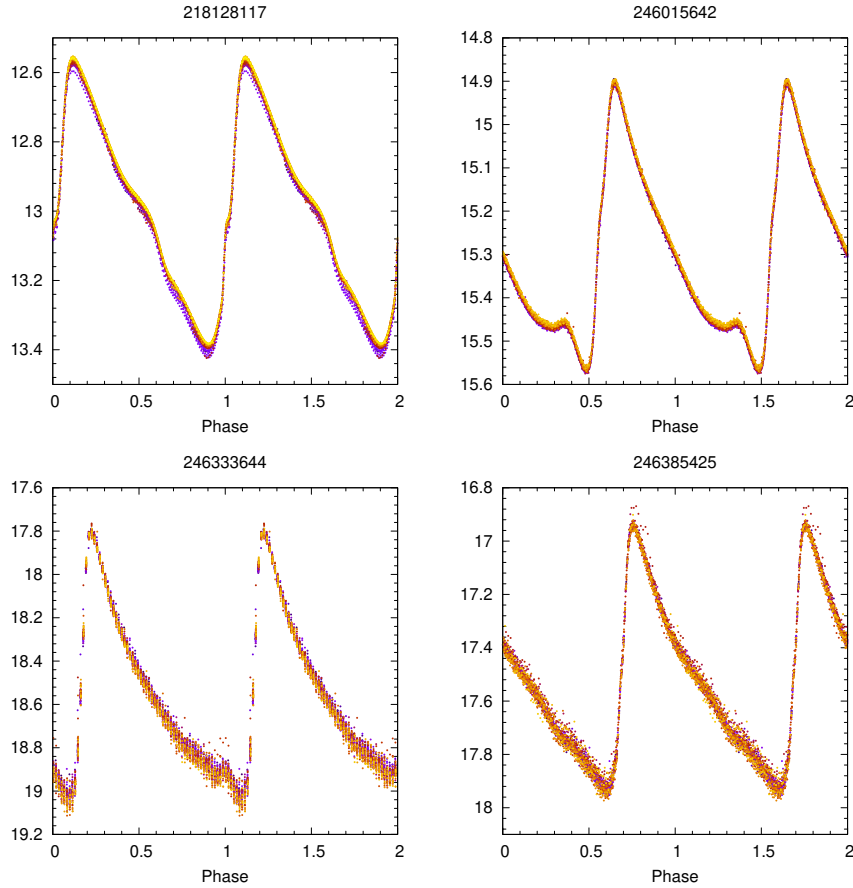


Fig. 1. The phased light curves of ACs in the K2 mission previously identified as T2Cs.

This project has been supported by the NKFIH K-115709 and PD-121203 grants of the Hungarian National Research, Development and Innovation Office and the Lendület program of the Hungarian Academy of Sciences, project No. Lendület LP2018-7/2019. MIJ acknowledges financial support from the Ministry of Education, Science and Technological Development of the Republic of Serbia through the project 176004. Research partially supported by the Délvidékért Kiss Foundation and Maria Lugaro's OTKA/NKFI-6 grant. LM was supported by the Premium Postdoctoral Research Program, EP by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.

References

- Luger, R., Agol, E., Kruse, E., et al. 2016, *AJ*, 152, 100
- Plachy, E., Klagyivik, P., Molnár, L., Sódor, Á., & Szabó, R. 2017, in *EPJ Web of Conferences*, Vol. 160, EPJ Web of Conferences, 04009